

Musée de l'Hotel Rolin. The toilsome journey to an altitude of 810 metres was amply repaid by a good lunch, and, in spite of the rain, by the more artistic pleasure of the grand panorama of surrounding plains and hills which is to be seen from the summit.

This visit to Mont Beuvray, a hill well known to the whole world, since it has justly given its name to an important epoch—the Iron age—recalled the fact that Cæsar once visited this Oppidum, and shortly after protected the Aedui from the Helvetian attack, and also from that of Ariovistus. It was here, too, that the Gauls held the famous general assembly, after the Aedui abandoned the Roman cause, and proclaimed Vercingetorix, the proclamation no doubt taking place near the *Pierre de Vibre*.

The ancient importance of this fortified Eduen camp is also attested by the fact that Cæsar, after the triumph at Alesia, established himself there. After this, Gaul was completely submitted to the Eastern civilisation, and *Bibracte* (with its *Beuvraysien*, i.e. its *industrie du Fer*), some years after the commencement of the Christian era, was completely obliterated by a forest fire. Vestiges of the town have been found by a modern Eduen, Bulliot, and a room in the Musée de l'Hotel Rolin is devoted to the results of the gigantic excavations. These were shown to the congressists by his worthy successor, M. Déchelette, who also exposed, for the congress, several Gaulish habitations, and prepared an exposure laying bare part of the old ramparts of the Oppidum, thus affording the visitors a view of a good example of the constructions of that epoch.

On August 16 an excursion to the boundary of the Côte d'Or and Saône and Loire occupied the attention of the congress, and a number of dolmens in the neighbourhood of Nolay and Decize were examined, but these do not recall anything of those well-known monuments on the borders of the Gulf of Morbihan. This visit showed what becomes of monuments in the centre of France, as those of the Field of Justice, in Saint Pantaléon, near Autun, had already appeared as an ultramicroscopic reduction of those of Menec and of Kerlescant at Carnac.

The evening was devoted to an enjoyable visit to the camp of Chassey, a typical Neolithic fortification occupied later by the Gallo-Romans. In the hands of the late director of the Musée Rolin, Dr. Loydreau, this camp furnished a valuable collection to the museum, and, thanks to the enthusiasm of M. R. Gadant, the room devoted to the collection was solemnly declared open during the visit of the congress. The subject of this second excursion was restricted entirely to the two principal periods of the polished stone epoch.

Looking south from Chassey, the far-away plateau of Aluze may be seen, considered by the Eduens as being the only Alesia possible. This supposition has not, however, prevented M. Etienne Bonneau from preparing his modest work, in spite of many difficulties, on the *Siège d'Aluze par J. César*.

At the camp of Chassey, of which the northern and southern parts of the vallum remain intact, excavations had been specially preserved, and furnished the visitors numerous fragments of Neolithic pottery and remains of Bovides, &c.

The third day was devoted to the Palæolithic age, to the period of the *pierre taillée*, and to this end the congressists visited the very fine collection made by Arcelin père from the classical beds of Solutré, and now to be found in the Musée de Mâcon. The son of the inventor of Solutré, Dr. Arcelin fils, was the guide, and had prepared a new cutting of the *Clos du Charnier*, which showed *in situ* the exact stratification of the beginning of *Solutréen*. As has already been mentioned, this visit did not give the key to the thorny question of *Présolutréen* or *Aurignacien*, on which sides are taken by the leaders of the Belgian and French brigades.

But the old school of prehistoric France showed that the Solutré bed has been greatly modified by the earth displacements, and so rendered little assistance to the solution of the Aurignacien problem. Against this the few facts have shown that the layers, as known, of horses, which form the base of the station, appear to be contemporaneous with the *Mousterien*. In fact, it appears,

a priori, that one such place which had been frequented by the Palæolithic workmen had also been inhabited by the Solutréens. Certain flints, and remains of horses, apparently prepared on the Mousterienne model, have been found by Drs. Arcelin and Baudouin.

On the last day of the excursions a visit was made to the Oppidum d'Alesia, where there are rare traces of the Gaulois (huts, &c.). The epoch appears to be completely the Gallo-Roman, i.e. at the end of the Iron age. Here is to be seen the result of two years' assiduous labour, and one sees that if Faith is not able to raise mountains, Science of to-day is able to dig out from their foundations the majestic ruins of several successive Roman civilisations. In face of these works, the question which suggested itself was, "If by some unlikely chance this was not the true Alesia, how is it that a town, having presented such elaborate monuments, has left no trace of itself in the primitive history of France?"

This visit, with that to the two special walls which were seen at *Alise Sainte Reine*, worthily brought the congress of Autun to a close.

As a proof of the enthusiasm aroused, it may be stated that the last excursion attracted more than 100 participants. In spite of the complexity of the excursion programme, and in spite of the large number of adherents, the congress programme was carried out punctiliously.

The splendid organisation of this Congrès préhistorique de France may henceforward remain a model for others. It is to be hoped that its success will be repeated upon the occasion of the fourth congress in 1908, and that a still greater number of foreign workers, more especially the specialists of Great Britain, will be present.

ECONOMIC BIOLOGY AND AGRICULTURE.

A CONFERENCE to mark the inception of a new department of economic biology at University College, Bristol, was held on Thursday, October 17, in the Bristol Museum, the Right Hon. Henry Hobhouse, P.C., taking the chair.

Mr. A. D. Hall, director of the Rothamsted Experimental Station, speaking upon the experimental work at Rothamsted, directed attention to the part played by bacteria in the fixation of nitrogen in the soil. Mr. E. S. Salmon (Agricultural College, Wye) referred to the destructive character and prevalence of fungus pests, and the beneficial results following the use of various spray solutions. Mr. F. V. Theobald (vice-principal Wye College), in dealing with the investigations upon insect pests, urged the importance of each worker making his own observations upon their life-history and habits within the district in which he worked, otherwise much mischief would result from the repetition of misstatements. It has been found, for example, that the winter moth, the wingless females of which are supposed to emerge in the middle of October and ascend tree trunks to lay their eggs, does under certain conditions and in some districts appear earlier, so that grease banding of the trees in such cases carried out too late, and much damage results.

Prof. J. R. Ainsworth Davis (Aberystwyth), speaking upon economic biology in relation to fisheries, urged a much closer connection between educational work and trade. He also pointed out the need of a fuller knowledge of the movements of food fish, and the importance of organising systematic investigations upon the fisheries of the Bristol Channel and the rivers flowing into it. Mr. T. H. Middleton (Board of Agriculture and Fisheries), speaking upon the public and departmental aspects of economic biology, stated that it is the policy of the Board to subsidise institutions establishing departments of agriculture, recognising that the work of economic biologists is of public benefit, in that all are consumers. The result of disease and unscientific management leads to dearer food-stuffs. The Board has a special interest in the work of biologists, and can be made an effective intermediary between the scientific man and the grower. It is possible that a time will arrive when the Board will be able to do more in support of applied science, and when that time comes consideration will be given to those institutions

which have actively worked for the benefit of agriculture, forestry, and fisheries.

Mr. W. R. Barker, chairman of the Museum and Art Gallery Committee, said the committee of that institution recognises the beneficial effect of active cooperation with the University College of Bristol, and to that end is rapidly developing a special section of economic biology for the exhibition of insect and plant pests, and of material damaged by them. Prof. A. F. Stanley Kent explained that the new department has been called into existence by the needs of the west of England, and that applications for help and inquiry have come in rapidly. Valuable research work has already been carried on at the college in matters relating to economic biology, and important results have been obtained in connection with ciders, blackcurrant disease, and the development of lobsters on the coast of Devon and Cornwall. It was announced that Mr. Richardson Cross has offered land for an experimental station, where investigations upon various crops, manures, &c., can be carried on; additional land has also been offered by Mr. James Sinnott at St. Anne's Park. It is intended that the teaching side of the work shall be kept subsidiary to the advisory, and that the real function shall be to supply information and render help wherever required. Prof. Lloyd Morgan pointed out that academic and national interests in these matters are one, and that the department will directly benefit the community. Mr. W. E. Collinge (Birmingham) described the work of his department in the University of Birmingham, instancing as an example of the work done the yield from two orchards of the same acreage, and only separated by a road. One left unsprayed produced fruit worth 122*l.*; the other, that had been sprayed, produced fruit worth 497*l.*

SYNTHETICAL CHEMISTRY IN ITS RELATION TO BIOLOGY

IT is easy to understand why in its early youth organic chemistry was so closely connected with biology; the materials which the chemist was called upon to investigate were mostly products of animal or vegetable origin. Indeed, carbohydrates, proteins, and vegetable acids served Lavoisier, Gay-Lussac, Berzelius, and Liebig as materials in elaborating the methods of elementary analysis.

The isolation of urea from animal urine by Rouelle, the recognition of uric acid, lactic acid, malic acid, and glycerine by Scheele, the isolation of asparagine by Vauquelin and Robiquet, of morphine by Serturnier, together with many other similar discoveries accomplished during the first ten years of the nineteenth century, are admirable examples of the manner in which the living world was drawn upon and made to yield up its treasure of chemical compounds. The many hundreds of natural organic compounds enumerated in the text-books of animal and vegetable chemistry are proof of the rich harvest since gathered in this field of investigation; but how small is their number when compared with the 130,000 carbon compounds which organic chemistry can boast of to-day. All these, it is known, are either products of the artificial transformation of organic matters occurring naturally or have been completely synthesised from their elements. The accumulation of this huge material, including the elaboration of the necessary methods, has been the main occupation of organic chemists during the past sixty years; and as their discoveries gave rise to much happy speculation, for the time being they took the lead in developing chemical theory.

It is not to be denied that, in the latter half of the last century, owing to the growth of the subject in importance, organic chemistry became separated from biology. It cannot be mere chance that the most famous of Liebig's pupils, A. W. Hofmann, A. Kekulé, and A. Wurtz, did not follow the example of their great teacher, whose chief triumphs were won by the use he made of chemical methods in solving biological problems. Perhaps they were restrained by the feeling that, mainly through his

influence, physiological chemistry had been developed into a separate discipline, which should be cared for by men who could devote themselves entirely to its service. Such subdivision of labour undoubtedly has many advantages; the disadvantages would have outweighed these had it precluded interchange of experiences and friendly co-operation of workers in the two fields; the history of both sciences, however, affords ample proof that such has not been the case.

Physiologists have ever been ready to avail themselves of the latest developments of chemical analysis and synthesis, whilst organic chemists have not only been stimulated in many ways by biologists, but their studies have derived much practical aid from biological science. I may instance the modern development of the chemistry of fermentation, which began with the pioneer work of Pasteur, and was greatly favoured by the introduction of Koch's refined bacteriological methods; also the flourishing industry to which the manufacture of medical remedies prepared by synthetic methods has given rise.

But organic chemistry will certainly never be content to act as the mere handmaid of biology. This is impossible, as the theoretical and technical problems which she is already called upon to consider are too numerous, and they cannot fail to increase in number and importance in the future; but I do consider it not only possible, but desirable, that the close connection of chemistry with biology which prevailed in the days of Liebig and Dumas should be re-established, as the great chemical secrets of life are only to be unveiled by cooperative work. I will therefore attempt to indicate the part chemistry can play by reference to cases of which I can claim to have personal experience.

We know that in nature the construction of organic matter begins in the leaves of plants with the conversion of carbon dioxide into sugar, from which many physiologists suppose the complex substances contained in the living cell are formed by further changes in which nitrogen, sulphur, and phosphorus take part.

These transformations are for the most part enveloped in mystery. We know nothing definitely even of the assimilation of carbon dioxide. Of the various hypotheses advanced to explain the change, that advocated by A. von Baeyer has gained most support, namely, the view that the initial product is formaldehyde, glucose being formed from this by a process of polymerisation. Actually both changes have been effected artificially. After it had been shown by Butleroff that on heating formaldehyde with lime water a sugar-like, syrupy product is formed, and O. Loew had improved the method of effecting the condensation, I was able to adduce proof that the complex mixture contains a small quantity of an α -acrose which can be transformed into glucose. As it was known that carbon dioxide could be converted into formaldehyde by more or less drastic means, the preparation of glucose from carbon dioxide thus became a possibility. Recently, Fenton has succeeded in carrying out the reduction of carbon dioxide to formaldehyde at a low temperature in aqueous solution, so that it is now possible to effect the complete synthesis of sugar at temperatures such as prevail in the living plant. But how thorough is the work of the plant in comparison with our laboratory practice; usually when such questions are discussed, the poor yields which our methods give rise to are forgotten!

I need only allude here to recent, apparently successful attempts, on the one hand, to effect the reduction of carbonic acid to formaldehyde by means of light, and, on the other, to detect formaldehyde in green leaves, as Prof. Meldola dealt exhaustively and critically with these questions in his presidential address eighteen months ago. I may be allowed, however, to dwell somewhat on one peculiar feature of the natural change, namely, the asymmetric character of the synthesis: according to present experience, and especially the brilliant investigations of H. Brown and Morris, the optically active hexoses of the *d*-series, glucose and fructose, are alone formed.

But from the experience gained in effecting syntheses in the sugar group, as I showed some time ago, it is possible to give a fairly satisfactory explanation of this change. It is only necessary to assume that the condensation is preceded by the formation of an additive compound of

¹ Abridged from the Faraday Lecture delivered by Prof. Emil Fischer, F.R.S., at a meeting of the Chemical Society held at the Royal Institution on Friday, October 18.